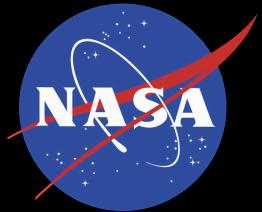


High Altitude Platform Aircraft at NASA Past, Present and Future



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*NASA Dryden Flight Research
Center*

HAP Applications Symposium
October 25, 2006
York, UK



Agenda

- NASA's Dryden Flight Research Center
- Past
 - Significant Accomplishments from Environment Research and Sensor Technology (ERAST) Project
- Present
 - HAP Applications: Needs and Opportunities
 - NASA Aeronautics Focus Shift
 - HAP Non-aeronautics Challenges
 - Current HAPS Capabilities at NASA
- Future

NASA's Dryden Flight Research Center



Our Vision: To Fly What Others Only Imagine

Our Mission: Advancing Technology and Science Through Flight

Mission Elements:

Perform flight research and technology integration to revolutionize aviation and pioneer aerospace technology,

Validate space exploration concepts,

Conduct airborne remote sensing and science observations,

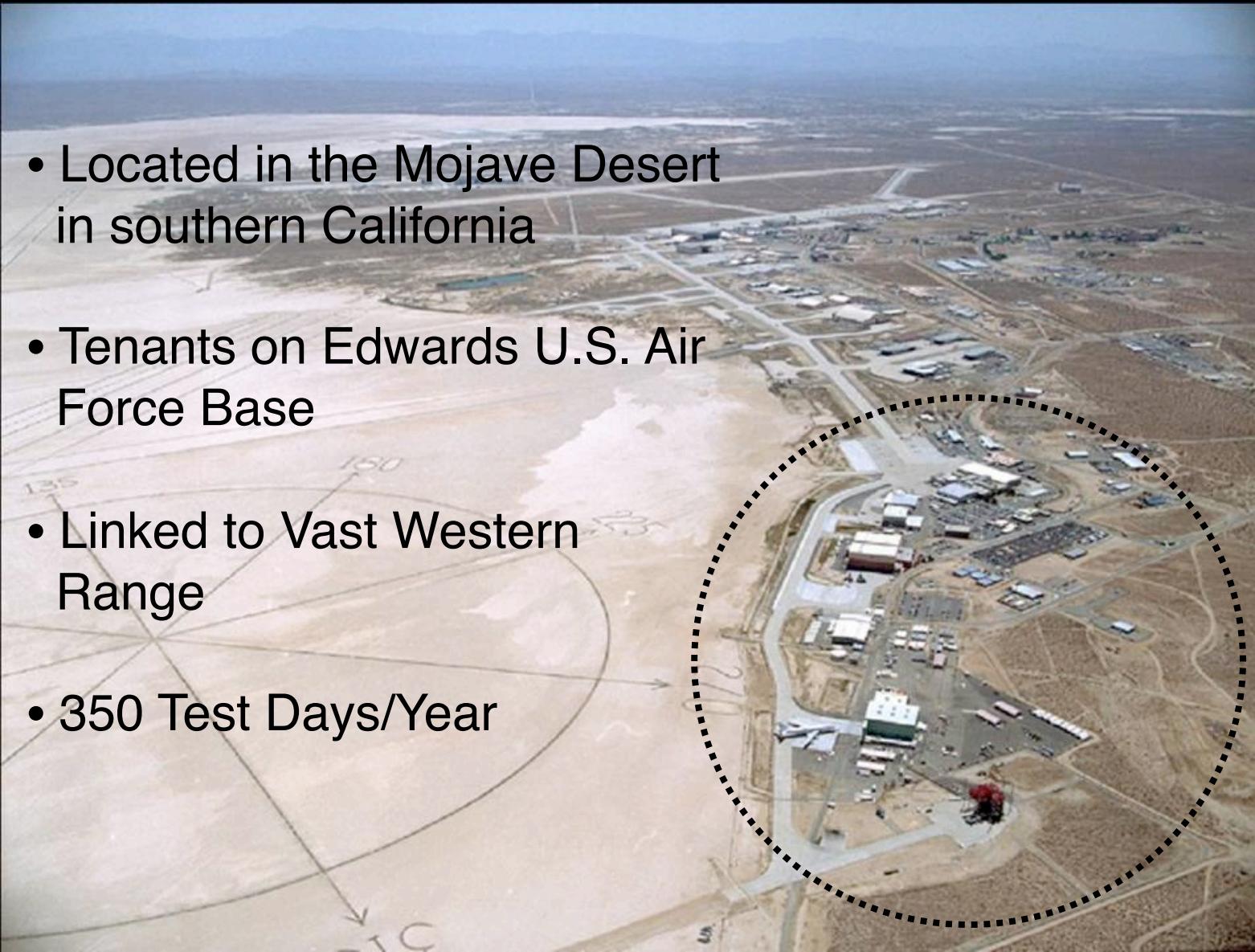
Support operations of the Space Shuttle and the ISS



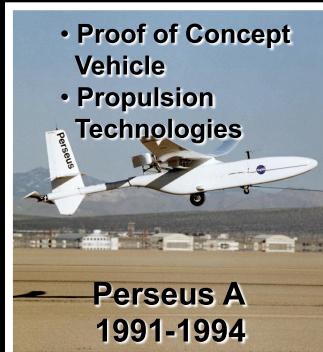
NASA - Dryden Flight Research Center Location



- Located in the Mojave Desert in southern California
- Tenants on Edwards U.S. Air Force Base
- Linked to Vast Western Range
- 350 Test Days/Year



Significant Accomplishments from the Environment Research and Sensor Technology (ERAST) Project (1994 - 2003)



Perseus A
1991-1994



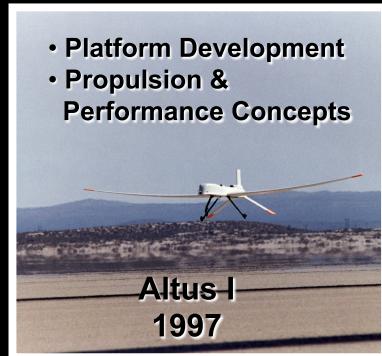
Pathfinder
1994-1997



Raptor D2
1996



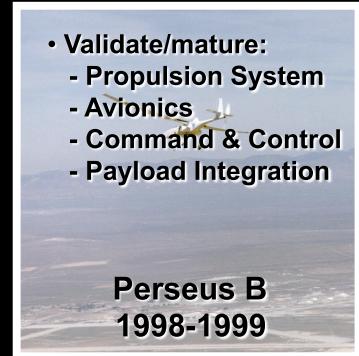
Centurion
1997



Altus I
1997



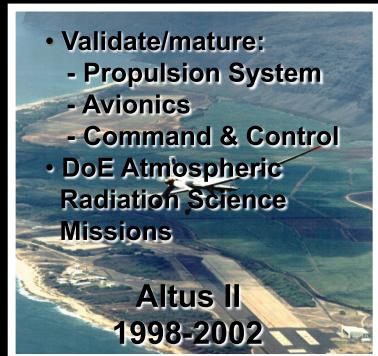
Pathfinder Plus
1997-1998



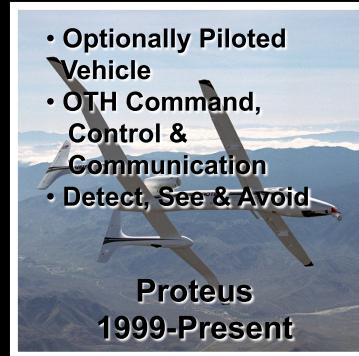
Perseus B
1998-1999



Helios
1998-2003



Altus II
1998-2002



Proteus
1999-Present



Altair
2003-Present



A Solar Powered HAP - Helios



Footage from 2001 deployment to the Hawaiian island of Kauai.

A World Record for Altitude of 96,863 ft (29.5 km) was set for a non-rocket powered aircraft.



HAP Applications, Needs and Opportunities



Commercial



Global high quality communications that truly connect the world

Science & Weather Forecasting



In-situ real-time global atmospheric information 24/7 sharply reducing uncertainties in atmospheric and weather models & forecasting

Resource Management



World-wide low-cost coverage of agriculture, water resources, forests, etc.

Surveillance & Disaster Monitoring



Reliable, low cost, flexible surveillance and communications platform



NASA Aeronautics Focus Shift

- NASA priorities have shifted towards Space Exploration.
- New Aeronautics Program has shifted its emphasis toward fundamental aeronautics:
 - Hypersonics
 - Supersonics
 - Sub-Sonic Fixed Wing
 - Sub-Sonic Rotary Wing
 - Integrated Vehicle Health Management (IVHM)
 - Integrated Resilient Aircraft Controls (IRAC)
 - Intelligent Integrated Flight Deck (IIFD)
 - Aircraft Aging & Durability (AAD)
 - Next Generation Transportation System (NGATS)
 - Airportal
- More information can be found at:
 - www.aeronautics.nasa.gov

Non-Aeronautical HAP Challenges in the U.S.



- Access to U.S. Airspace
 - 2006 a turning point with the Federal Aviation Administration (FAA).
 - FAA reorganizing to better address a very high demand for UAV flight approvals from the military, government agencies, and commercial companies.
- Access to Spectrum
 - Ku-type Satellite Communications is very expensive and over-subscribed.
 - When possible, UAV operators are taking advantage of Iridium and INMARSAT for both command and control and data.
 - The situation will likely worsen as more UAVs become operational.
- Liability and insurance.



Current HAP Capabilities at NASA



ER-2



Altair/Ikhana (Predator B)



Global Hawk (ACTD)



WB-57



Altair/Ikhana Project Overview



Ikhana Capabilities

- Endurance: 30 hours
- Ceiling altitude: ~ 50,000 ft (15.2 km)
- Payload: 2,400 lbs (1,089 kg)
- Ku satcom for over the horizon missions

Background & Status

- Altair is a Predator B variant; Ikhana is a Predator B.
- Ikhana to be delivered to NASA this month.

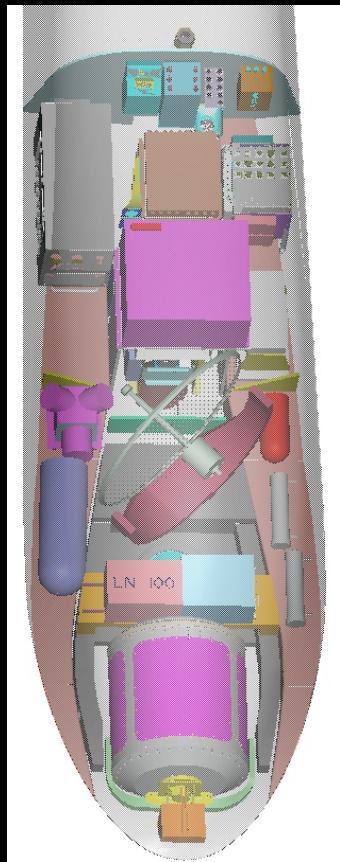
Missions

- Earth Science
 - USFS Fire detection mapping in 07
 - UAV AVE satellite validation in 08
- Unmanned Aerial System technology testbed
 - Fiber-optic Wing Shape Sensing
 - Collision Avoidance

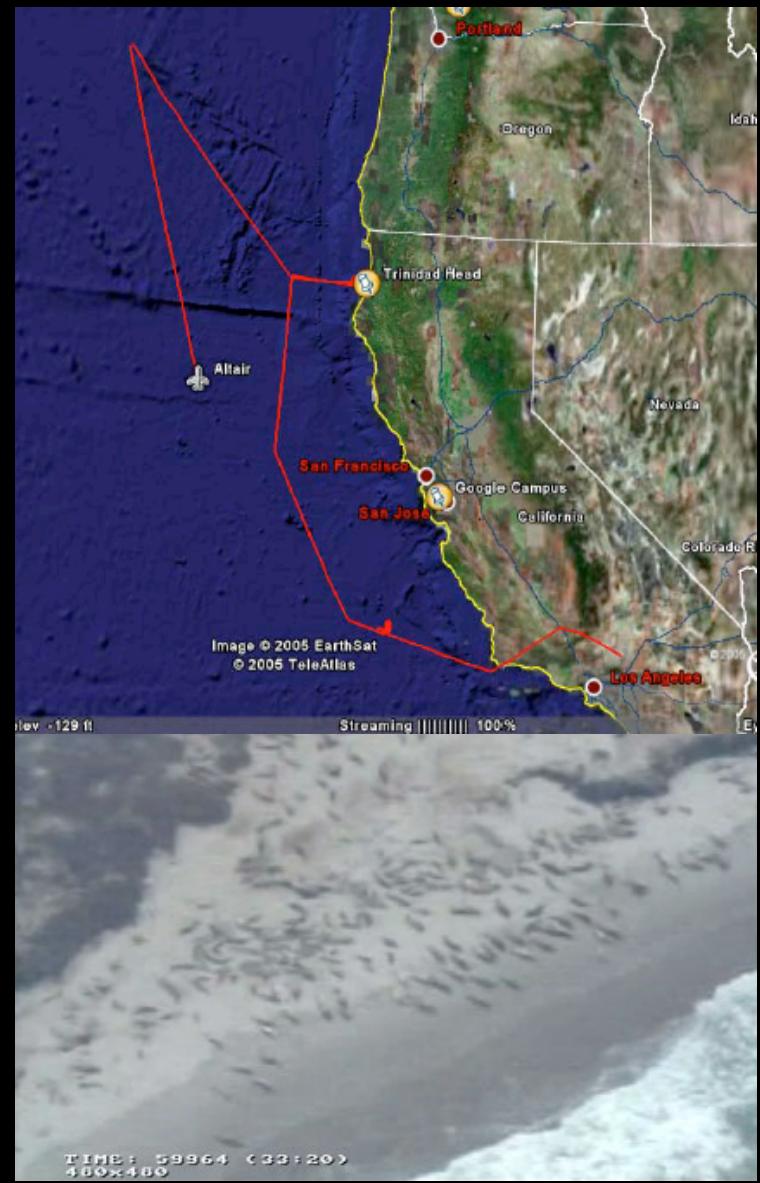
Ikhana Airborne Research Test System

- 3 processor research flight control and/or mission computer
- Able to autonomously control the aircraft and some systems
- Able to host research control laws

2005 NASA/NOAA UAV Demo



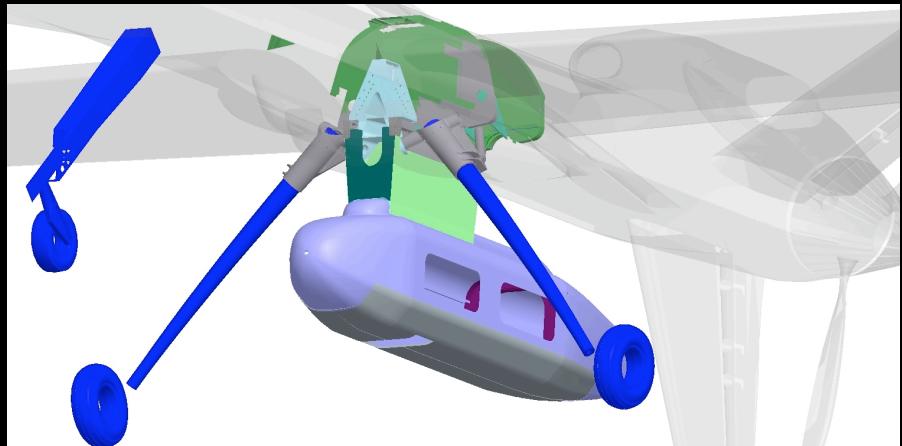
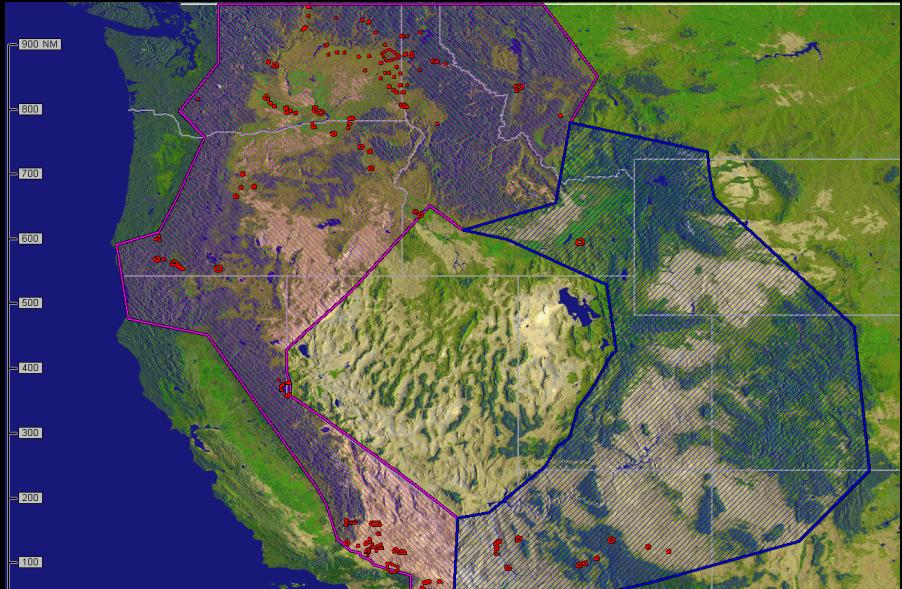
- 5 Missions using Altair
 - Durations up to 18.6 hrs
- Sensors
 - Ocean Color Sensor/
Passive Microwave Vertical
Sounder
 - Gas Chromatograph/
Ozone Instrument
 - Cirrus Digital Camera
System
 - REVEAL
 - EO/IR Skyball
- Objectives
 - Atmospheric river sampling
 - Marine sanctuary
surveillance/enforcement
 - Channel Island mapping
 - Ocean color profile
- Objectives achieved



2006 NASA/USFS Western States Fire Mission



- Multi-spectral camera to locate and map known and unknown forest fires.
- Thermo geo-rectified imagery provided to the National Interagency Fire Center in near real-time.
- Long duration (~20 hours) over-land operation in the NAS will provide challenges.



Example of Sensor Images for Fire Mission



Visible
(TM 3-2-1)



Infrared
(TM 6-7-5)



Castaic Fire, CA (8/26/96), 25m res., 65,000 ft AGL)

Altair-acquired imagery = 17m res. @ 45,000 ft and 9.5m at 25,000 ft



Global Hawk Overview



Capabilities

- Endurance: > 30 hours
- Ceiling altitude: 65,000 ft (19.8 km)
- Payload: > 1,500 lbs (> 680 kg)
- Ku Satcom and/or Iridium for over the horizon missions

Background & Status

- Original Global Hawk prototype aircraft built (#1 and #6).
- USAF is in the process of transferring the aircraft to NASA.
- The aircraft could be operational as soon as 2008.

Missions

- Communications systems testing
- Earth Science
- Payload development and testing
- In-situ measurements and collection
- Hurricane tracking



ER-2 Overview



Capabilities

- Endurance: > 8 hours
- Ceiling altitude: > 70,000 ft (21.3 km)
- Payload: 2,600 lbs (1,180 kg)
- Range: > 4,000 miles (> 6,400 km)

Background & Status

- Two aircraft (806 and 809); variants of the military U-2 aircraft.
- Serving NASA since the early 70's.

Missions

- Remote sensing
- Satellite calibration/validation
- In-situ measurements and atmospheric sampling
- Instrument demonstration, test and evaluation

Versatility

- Multiple locations for payload instruments
- Pressurized and un-pressurized compartments
- Standardized cockpit control panel for activation and control of payload instruments.
- Iridium communications system



WB-57 Overview



Capabilities

- Endurance: approx. 6.5 hrs
- Ceiling altitude: > 60,000 ft (> 18 km)
- Payload: 6,000 lbs (2,721 kg)
- Range: approx. 2,500 miles (4,000 km)

Background & Status

- Two aircraft available.
- Serving NASA since 1969.

Missions

- Remote sensing
- In-situ measurements and atmospheric sampling
- Instrument demonstration, test and evaluation
- Space Operations launch video support.

Versatility

- Removable pallet for ease of payload installation
- Pressurized and un-pressurized pallet locations are available.

NASA Near Term and Long Term Plans



- Near Term
 - NASA will use the existing fleet of HAPs to conduct a variety of missions.
 - NASA expects to take advantage of access to the U.S national airspace.
 - Operations of our HAPs are expected to yield valuable operational experience that can be used to further improve these aircraft systems.
- Long Term
 - Scientists at NASA and other U.S. agencies are meeting routinely to plan different missions that will take advantage of these special aircraft.
 - Hurricane tracking missions.
 - Polar missions to monitor the state of the ice caps over long periods of time.
 - A return to HAP technology development is always a possibility.



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